

## SESSION 8 – Environmental Issues

### **TRANSMAP: An Integrated, Real Time Environmental Monitoring and Forecasting System for Highways and Waterways in Rhode Island**

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#### **PROJECT DESCRIPTION:**

**Problem statement:** Environmental data is critical for effective operation, management, and evaluation of various land and marine transportation systems. For landside systems (road weather information systems, RWIS) this data is typically used to assist in road maintenance (snow plowing) and treatment (salting/deicing) in winter, traffic control and planning, responding to accidental releases of material in transport (chemical or petroleum spills) and in evaluating the performance of various transportation systems (e.g. roadbed material monitoring). For marine operations the data is typically provided to vessel operators and pilots to assist in the safe transport of people and bulk and containerized cargo.

A review of the commercially available RWISs shows that individual companies that market such systems have developed them independently. The instrumentation, sensors, data handling procedures, communication protocols, and the software to visualize and display the data and support the integrated system of models (ice forecasting, road salting optimization) and management support modules are proprietary. The user must rely on the supplier for any changes in the system or to integrate other sensors into the system. The RWIS generally have base maps (fixed or pre-determined views) and very limited or no geographic information system (GIS) functionality. Extension of the system to new areas or the addition of new models or management modules must also be performed by the system developer. The systems also do not allow the user to perform any independent analysis of the data. Even when data analysis modules are included the user is unable to modify or customize them for their application. Often the developer installs the systems and the user is never given the administrative password and hence can't access their own data nor export the data to other software. These constraints, namely closed architecture and limited functionality, substantially limit the utility of the systems. In many cases the RWISs also don't take advantage of the newest development in software systems and tools. As an example, distribution of the data products via the Internet, through web servers, is just now being offered and only by a few suppliers.

On the marine side the systems have been specifically established to support marine transportation for selected major harbors and ports in the US. The presentation of data is standard for all federal government systems (e.g. NOAA PORTS) and is given either in terms of the most recent observations or recent tabulated time series data in graphic form. For other systems the formats vary from area to area and based on who collects the data.

Access is often very difficult and restricted. Historical data is generally not maintained or available. Access to these systems, via the Internet, generally does not allow for integration with models, nowcasting/forecasting tools or management support systems, data analysis modules, or incorporation of GIS functionality.

None of the existing systems include both land and marine based observations, even though data needs between the two are quite common. This is a particular issue for coastal states where the meteorological conditions are strongly impacted by the proximity of the land water interface.

Project objectives: The broad goal of the present project is to develop a fully integrated real time monitoring and modeling system to provide environmental and pavement condition data for highways and waterways in RI. The system, called TRANSMAP (Transportation Mapping and Analysis Program) features an open architecture, industry standard software tools and modules, an embedded GIS, standardized data handling protocols, an environmental data analysis and presentation system, and access for linking of models and management tools. The specific objectives of the project are to (1) develop an integrated system for monitoring and forecasting of environmental conditions on RI highways and waterways in support of the RI Department of Transportation and the RI transportation community, (2) implement, test, and evaluate the performance of this system in RI and adjacent coastal waters, (3) transfer the data products and forecasts to interested RI DOT operations staff, major transportation user groups, and the public, and (4) transfer the system for commercialization by private industry.

Project payoff: This project will develop the first real time, integrated environmental monitoring and forecasting system for land and marine based transportation in the nation. The data collected will be available to University of RI (URI) Transportation Center researchers, to RI Department of Transportation (RI DOT) personnel, to major transportation groups in the state, and to the public. The system will strengthen the RI DOT operational road weather information systems (RWIS) by the addition of monitoring stations and model forecasting functionality and will provide information on weather and pavement conditions for other researchers at URI. Selected data products will be available to the public and transportation user groups via the Internet and allow them to determine weather and local offshore conditions (e.g., Narragansett Bay and Rhode Island Sound). The system can be readily transferred to any other location in the US and the world.

**PROGRESS TO DATE:** The basic framework of TRANSMAP has been constructed and the system is currently operational for RI and adjacent coastal waters. The system provides access to a variety of existing, real time meteorological and marine measurement systems (e.g. NOAA PORTS, RI DOT RWIS, NWS' ETSS Sub-Tidal Water Level forecasting model, and NOAA/NOS COFS forecasting model). Models that allow real time prediction of the temperature profile in the roadbed as a function of time and location and the prediction of the evaporative plume and zone of concern from land based spills of hazardous chemicals (ALOHA) have been developed and integrated within the TRANSMAP framework. Tools have also been developed to access data from

GIS databases and to display these as overlays on the system base map. TRANSMAP's embedded GIS functionality is based on the industry standard GIS system ArcInfo (ESRI Software) allowing for extensive compatibility with existing GIS archives. A suite of data analysis tools (statistics, filtering, spectral analysis, harmonic analysis) have been developed and implemented to allow real time analysis of data from any observation station. A prototype version of TRANSMAP has been installed in the Maintenance Office of RI DOT and is currently undergoing evaluation.

**FUTURE PLANS:** The first year and one half of the three-year project has been completed. The principal tasks for the remainder of the project are (1) to fully implement the system and provide system installation and operational training to RI DOT (Maintenance Division and Transportation Management Center) and DEM staff and make appropriate modifications to meet their specific needs, (2) to implement and validate the thermal energy balance model that will allow predictions of road surface temperature using data from in-situ sensors and to evaluate model performance in nowcasting and forecasting applications, (3) to extend and improve the Internet/Web access to the system, including the ability to animate observations and forecasts and to assist public transport groups (e.g. AAA, RI Public Transit Authority, Water Cruises) in setting up Internet access for internal and public use, (4) to test the application of the ALOHA hazardous materials response model in cooperation with the RI DEM Hazardous Materials response team, (5) to link TRANSMAP with a high resolution weather forecasting model currently under development for southeastern New England, and (6) to transfer the technology developed in this project to private industry for commercialization.

**PRODUCTS:** The following reports and presentations have been made:

Reports

Spaulding, M.L., K. Korotenko, T. Opishinski, and C. Galagan, 2001, TRANSMAP: An integrated, real time environmental monitoring and forecasting system for highways and waterways in RI, University of Rhode Island Transportation Center, Kingston, RI March 2001.

Presentations

Seminar presented at University of Rhode Island, Ocean Engineering Seminar Series on February 1, 2001 entitled: *Development an integrated system for monitoring and forecasting environmental condition on roadways*, Dr. Konstantin Korotenko, Department of Ocean Engineering, University of RI, Narragansett, RI.

Seminar presented at the 13th RI Transportation Forum, held at the University of Rhode Island, Kingston, RI, October 13, 2000, entitled: *TRANSMAP: An integrated, real time environmental monitoring and forecasting system for highways and waterways in RI*, Malcolm L. Spaulding and Konstantin Korotenko, Ocean Engineering, University of Rhode Island, Narragansett, RI, Chris Galagan , Applied Science Associates, Inc., Narragansett, RI, and Tom Opishinski, Interactive Oceanographics, East Greenwich, RI.

Prototype system installation

A prototype version of TRANSMAP has been installed at the RI Department of Transportation Maintenance Center and is currently undergoing evaluation.

## **Hawaii Pilot Project to Build a National Early Warning System for Invasive Species**

### **PRINCIPLE INVESTIGATORS:**

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**PROJECT DESCRIPTION:** Any organism, intentionally or unintentionally, introduced into a habitat other than the one it evolved in has the potential to cause environmental and economic damage and/or harm to human health. Such species are generally referred to as invasive, alien, exotic, nonindigenous, and/or a nuisance and are second only to habitat destruction in causing a decline in biodiversity. Invasive species affect all regions of the United States and every nation in the world. In the United States alone there are approximately 50,000 exotic species with those numbers increasing every day. The major environmental damages, losses, and control measures add up to more than \$138 billion per year and invasive species impact nearly half of the species currently listed as threatened or endangered under the US Federal Endangered Species Act. The rapid global expansion of maritime transport, hull fouling and ballast water releases of ships, aquaculture, the aquarium trade, the import of species as biological control agents, live bait, and for scientific research all facilitate the introduction of exotic species to habitats.

The Early Warning System for Invasive Species web site will begin as pilot project in the state of Hawaii to develop and test a national system. The web site will offer coastal resource managers and scientists an interactive tool to obtain the latest information on and verify new sightings of native and non-native US coastal marine species.

- The primary objective of the web site is to provide resource managers an early warning of the introduction of a potentially invasive species. This will be accomplished by comparing newly collected data with a pre-existing baseline list of US coastal marine species. In the event that a newly collected specimen is not listed as established in that geographical region, then a warning will be automatically posted on the web site homepage.
- The second objective is to facilitate communication among the invasive species community, especially between managers and invasive species experts. The web site will provide managers, scientists, and taxonomists the ability to register on-site, document non-native species sightings, verify identifications of species that may be new to a region with taxonomic experts, obtain information on non-native species by biogeographic region, and share management successes and failures in controlling invasive species.
- The third objective is to develop the querying and operational functionality of the underlying pilot database, test the efficacy of the Early Warning System, and evaluate

the utility of a national web site to coastal resource managers. Modifications will be made as the pilot is developed and regional databases are added to tailor the system to its clients and achieve overall robustness of the web site.

This early warning system will provide coastal resource managers a valuable head start to begin eradication measures to reduce potential impacts from invasive species.

**PROGRESS TO DATE:** This pilot project is in its initial stages of development. Partners are coalescing electronic data sets of disparate Hawaiian collections into consistent lists of species by taxa (e.g., mollusks, fish, algae) databases that will be quality-assured and integrated within the year to build the baseline list of coastal marine species. One or more contracts will be awarded to begin build the system and web site.

**FUTURE PLANS:** It is envisioned that this pilot project is the first in a series of acquisitions of regional data sets that collectively will list all native and non-native species identified from US the coastal waters of US states, territories, and possessions; thereby, building a national early warning system. Both the Hawaii Pilot Project and the ultimate national early warning system for invasive species is a needed, innovative bioinformatics product with a broad partnership/client base that will be of great potential benefit to the nation.